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Twelfth Annual Swine Field Day 1968 Complete Report

Department of Animal Science
South Dakota State University

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BROOKINGS, SOUTH DAKOTA

Swine Field Day

Contents

South Dakota State University
Brookings, South Dakota
Department of Animal Science
Agricultural Experiment Station

A.S. Series 68-27

A Study of Distillers By-Products in Growing-Finishing Swine Rations

Richard C. Wahlstrom and Craig German

Several by-products of the distillery, fish and cheese industries have been reported to give growth responses when added to swine rations thought to be adequate in known nutrients. It is known that these by-product feeds are good sources of many vitamins and minerals and it has been postulated that they may contain other "Unidentified Growth Factors" (UGF) that may be required by the pig.

The experiments reported herein were conducted to study the effect of distillers dried grains with solubles (DDG/S) on ration digestibility as well as its effect on growth and feed conversion of growing-finishing swine.

Experimental Procedure

In the first experiment 48 weanling crossbred pigs weighing approximately 39 lbs. were randomly allotted into eight lots of six pigs each. Two lots received each of the following experimental treatments:

1. Corn-soybean meal basal
2. Basal plus 5% DDG/S
3. Basal plus 10% DDG/S
4. Basal plus 20% DDG/S

The composition of the rations fed is shown in table 1. Feed and water were provided ad libitum, waterers were located in the house while feeders were in connecting outside pens. Digestibility was determined by the chromic oxide indicator method on three separate days. The trial was terminated when the pigs averaged approximately 200 lbs.

In trial II, 100 pigs were allotted, 5 pigs per lot, into two replicated groups of 10 lots each. The rations shown in table 2 were similar to those used in trial I except that lard was added as an energy source to those rations containing distillers by-products in order to equalize all rations in energy content. Lysine was added to the rations fed to treatments 6 through 10 in order to equalize these rations at 0.75% lysine. The pigs averaged approximately 42 pounds initially and were removed at a weight of about 125 lbs. The experimental treatments were as follows:

1. Corn-soybean meal basal
2. Basal plus 2% distillers solubles

3. Basal plus 5% DDG/S
4. Basal plus 10% DDG/S
5. Basal plus 20% DDG/S
6. Basal plus 0.10% lysine
7. Treatment 2 plus 0.11% lysine
8. Treatment 3 plus 0.13% lysine
9. Treatment 4 plus 0.17% lysine
10. Treatment 5 plus 0.25% lysine

Results

Trial I

Results of the first trial are summarized in table 3. Average daily gain was not significantly different in any of the lots although the pigs receiving the 20% level of distillers dried grains with solubles gained slightly slower in both replicates. Pigs in replicate 1 gained significantly faster than those in replicate 2. These pigs were heavier and also younger at the start of the experiment and thus had exhibited faster pre-weaning gains which were maintained from weaning to market weight.

Feed efficiency was significantly reduced when pigs were fed rations containing the high (20%) level of DDG/S. This higher feed requirement may be due, at least in part, to a higher fiber, lower energy and lower lysine content of this ration. Apparent digestibility of crude protein and dry matter was reduced in the rations containing DDG/S with the greatest reduction being when the ration contained 20% DDG/S.

Trial II

The growth performance data for trial II are summarized by treatment in table 4. Data for the two replicated lots per treatment are combined since lot differences were small. Gains were quite similar between lots although pigs fed the 20% level of DDG/S again gained at the slowest rate. Feed efficiency was also decreased when pigs were fed the 20% DDG/S. However, when lysine was added to this ration feed efficiency was similar to that of the other treatments.

It would appear that in rations of equal energy content levels of up to 10% DDG/S can be used without affecting rate or efficiency of gain. There was no evidence in this trial of unidentified growth factors being present. Replacing 20% of the corn and soybean meal in this ration with DDG/S reduced the lysine content 0.15% which may have affected rate and efficiency of gain since the main benefit from lysine supplementation in this trial was in the ration containing 20% DDG/S.

Summary

Two experiments were conducted and failed to show any presence of unidentified growth factors in rations containing distillers dried grains with solubles at levels of 5, 10 or 20%. Gains and feed efficiency of pigs

fed rations containing 5 or 10% DDG/S were equal to those of pigs fed a corn-soybean meal ration. Slightly slower gains and a higher feed requirement were found when pigs received rations of 20% DDG/S. Pig performance was improved when lysine was added to this ration.

Apparent digestibility of crude protein and dry matter was reduced when distillers dried grains with solubles was added to a corn-soybean meal ration.

Table 1. Composition of Rations (percent), Trial I

	Basal	5% DDG/S	10% DDG/S	20% DDG/S
Ground yellow corn	82.4	79.45	76.3	70.3
Soybean meal, 50%	15.0	13.0	11.15	7.2
DDG/S	--	5.0	10.0	20.0
Limestone	0.75	0.75	0.8	0.9
Dicalcium phosphate	0.85	0.80	0.75	0.6
T M salt (0.8% Zn)	0.5	0.5	0.5	0.5
Vitamin-antibiotic mix[a]	0.5	0.5	0.5	0.5
Zinc oxide, gm.	3.5	3.5	3.5	3.5

[a] Provided 1500 I.U. vitamin A, 150 I.U. vitamin D, 0.5 mg. riboflavin, 2.5 mg. calcium pantothenate, 7.5 mg. niacin, 50 mg. choline, 8 mcg. vitamin B_{12} and 10 mg. Pro-Strep per pound of ration.

Table 2. Composition of Rations (percent), Trial II

	Basal	2% DS	5% DDG/S	10% DDG/S	20% DDG/S
Ground yellow corn	82.3	81.1	79.2	75.9	70.0
Soybean meal, 50%	15.0	14.2	13.0	11.0	6.6
Distillers Dried Sol.	--	2.0	--	--	--
DDG/S	--	--	5.0	10.0	20.0
Limestone	0.7	0.7	0.7	0.8	0.8
Dicalcium phosphate	1.0	1.0	0.9	0.8	0.7
T M salt (0.8% Zn)	0.5	0.5	0.5	0.5	0.5
Vitamin-antibiotic mix[a]	0.5	0.5	0.5	0.5	0.5
Lard	--	--	0.2	0.5	0.9

[a] Provided 1125 I.U. vitamin A, 340 I.U. vitamin D, 2 mg. riboflavin, 4 mg. calcium pantothenate, 9 mg. niacin, 10 mg. choline chloride, 10 mcg. vitamin B_{12} and 10 mg. chlortetracycline per lb.

Table 3. Results of Feeding DDG/S to Growing - Finishing Swine

	Replicate	Basal	5% DDG/S	10% DDG/S	20% DDG/S
No. of pigs	1	6	6	6	6
	2	6	6	6	4[a]
Av. init. wt., lb.	1	40.3	40.5	40.5	40.5
	2	37.5	37.5	37.5	39.5
Av. final wt., lb.	1	204.8	210.3	203.3	201.2
	2	198.0	201.3	194.7	195.5
Av. daily gain, lb.	1	1.79	1.89	1.77	1.72
	2	1.68	1.69	1.67	1.56
	Av.	1.73	1.79	1.72	1.65
Av. feed per lb. gain, lb.	1	3.36	3.09	3.19	3.60*
	2	3.06	3.30	3.15	3.57*
	Av.	3.21	3.20	3.17	3.59*

[a] Two pigs removed.
* Significant ($P < .05$).

Table 4. Gain and Feed Efficiency Data, Trial II

Treatments	No. of pigs	Av. initial wt., lb.	Av. final wt., lb.	Av. daily gain, lb.	Av. feed per lb. gain, lb.
Basal	10	42.4	126.0	1.67	2.78
2% Distillers Sol.	10	42.4	123.2	1.58	2.82
5% DDG/S	9[a]	42.8	124.7	1.65	2.87
10% DDG/S	10	42.4	125.6	1.70	2.87
20% DDG/S	10	42.3	117.2	1.50	3.28
Basal + 0.1% lysine	10	42.3	125.8	1.70	2.97
2% DS + 0.11% lysine	10	42.4	125.8	1.67	2.82
5% DDG/S + 0.13% lysine	10	42.4	126.2	1.68	2.82
10% DDG/S + 0.17% lysine	10	42.3	124.0	1.70	2.73
20% DDG/S + 0.25% lysine	10	42.3	123.8	1.60	2.89

[a] One pig died.

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A.S. Series 68-28

Effect of a Controlled Environment on the Performance of (1) Heavy and Light Weight Pigs and (2) Barrows and Gilts

Richard C. Wahlstrom and J. F. Fredrikson

The trend in swine housing during recent years has been toward controlled environment buildings. These buildings generally contain slotted or partially slotted floors. Labor requirements in structures of this type are apt to be less than with conventional type buildings. Also of concern to the pork producer is the performance of growing-finishing pigs in these buildings compared to the performance in less costly structures.

The purpose of the experiment reported herein was to study the performance of heavy and light weight pigs and also of barrows and gilts allotted separately when housed in different environmental conditions during December, January, and February.

Experimental Procedure

One hundred forty-four crossbred SPF pigs were assigned on December 18, 1967 to two replicates of four groups. One replicate was housed in an insulated, ventilated, controlled environment house while the other replicate was housed in an open front house with adjoining outside concrete pens where feed and water were available. The four groups in each house were: heavy weight pigs, light weight pigs, barrows and gilts. The heavy weight pigs averaged 110 pounds initially compared to 39 pounds for the light weight pigs. The complete ground mixed rations used in this trial are shown in table 1. A 16% protein ration was fed up to a weight of approximately 110 pounds and a 12% protein ration was fed from then to the end of the trial.

Results

Results of this trial are summarized in table 2. Several comparisons can be made in this data. The heavy weight pigs gained faster but required considerably more feed than the light weight pigs as might be expected, especially since the lighter pigs were fed from weights of about 40 to 150 pounds compared to the heavy pigs from 110 to 210 pounds. These groups contained a combination of barrows and gilts. The groups of barrows gained faster than the gilts when both were fed separately and also gained faster than the heavy weight pigs although averaging 45 to 50 pounds lighter initially. There did not appear to be any real difference in the feed efficiency of barrows or gilts when fed over a similar weight period.

The data of all 72 pigs fed in each type of house was combined in order to compare the two types of housing. Pigs housed in the controlled environment house had an average daily gain of 1.65 pounds per day and required 3.42 pounds of feed per pound of gain compared to a daily gain of 1.70 and feed efficiency of 3.46 for the pigs in the uninsulated, open front house. These data support previous research which also indicated pigs housed in the open front type building gained equally as well as those in a more controlled environment. However, in previous work considerably more feed has been required by pigs in the open front house. The winter of 1967-68 was much milder than normal with almost complete absence of snow during this period which may account for the better performance this past winter.

Summary

Pigs from 110 to 210 pounds gained about 7% faster but required 24% more feed per unit of gain than pigs from 40 to 150 pounds. Barrows gained about 9% faster than gilts with essentially the same feed efficiency. The performance of pigs housed in a controlled environment building was similar to that of pigs housed in an uninsulated, open front building with outside feeding area.

Table 1. Composition of Rations, Percent (Winter 1967-68)

	To 110 lb.	110 to market
Ground yellow corn	76.8	87.2
Soybean meal, 44%	20.0	10.0
Dicalcium phosphate	1.5	1.0
Ground limestone	0.7	0.8
Trace mineral salt	0.5	0.5
Vitamin-antibiotic mix[a]	0.5	0.5

[a] Provided 1500 I.U. vitamin A, 150 I.U. vitamin D, 1 mg. riboflavin, 2.5 mg. calcium pantothenate, 7.5 mg. niacin, 50 mg. choline, 5 mcg. vitamin B_{12} and 5 mg. oxytetracycline per pound of ration.

Table 2. Results of Winter Trial (1967-68)

	Heavy Pigs	Light Pigs	Barrows	Gilts
Controlled Environment House				
No. of pigs	18	18	18	18
Av. initial wt., lb.	109.5	39.4	59.2	68.1
Av. final wt., lb.	207.3	149.3	182.3	183.1
Av. daily gain, lb.	1.69	1.55	1.73	1.62
Av. daily feed, lb.	6.37	4.83	5.89	5.50
Av. feed per lb. gain, lb.	3.78	3.12	3.40	3.39
Uninsulated House				
No. of pigs	18	18	18	18
Av. initial wt., lb.	110.4	38.1	64.6	66.3
Av. final wt., lb.	210.3	154.3	193.2	182.8
Av. daily gain, lb.	1.72	1.64	1.81	1.64
Av. daily feed, lb.	6.62	4.84	6.49	5.68
Av. feed per lb. gain, lb.	3.84	2.95	3.59	3.46

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A.S. Series 68-29

Spectinomycin - A New Antibiotic

Richard C. Wahlstrom

Antibiotics have become standard ingredients in most rations for growing swine. Antibiotic feeding generally increases average daily gains, improves feed efficiency, improves uniformity of performance and may reduce death loss during the growing period.

The exact method by which antibiotics cause these beneficial effects is not known. However, they apparently do have an influence on the intestinal bacteria and there is concern that the bacteria may become resistant to an antibiotic when fed continually. Therefore, new antibiotics must be evaluated and compared with existing effective antibiotics.

Experimental Procedure

Two trials were conducted to evaluate a new antibiotic, spectinomycin, in swine rations. In trial I, 54 crossbred pigs approximately 3 weeks of age and averaging 14 lbs. in weight were weaned and placed directly on the experiment which was conducted for 35 days. The pigs were allotted into lots of six and three lots received each of the following treatments:

1. Basal ration
2. Basal ration plus 10 gm. of spectinomycin per ton
3. Basal ration plus 100 gm. of spectinomycin per ton

Water and feed were provided ad libitum in inside cement floored pens.

Trial II was conducted with pigs weighing approximately 36 lbs. initially and they were removed from the experiment at an average weight of about 200 lbs. Eighty crossbred pigs were randomly allotted into 16 lots of five pigs each. Four replicated lots received each of the following ration treatments:

1. Basal ration
2. Basal ration plus 10 gm. spectinomycin per ton
3. Basal ration plus 20 gm. spectinomycin per ton
4. Basal ration plus 20 gm. chlortetracycline per ton

The pigs were housed in temporary houses placed on a concrete slab. Feed and water were provided ad libitum in outside lots. The basal rations used in these two trials are shown in table 1.

Table 1. Composition of Basal Rations, Percent

Crude Protein, %	Trail I 20%	Trial II 16%
Ground yellow corn	38.0	79.5
Rolled oats	30.0	--
Soybean meal, 50%	24.0	17.5
Sugar	5.0	--
Dicalcium phosphate	1.6	1.7
Ground limestone	0.6	0.6
Trace mineral salt	0.5	0.5
Vitamin premix	0.3[a]	0.2[b]

[a] Provided 1135 I.U. vitamin A, 340 I.U. vitmamin D, 4 mg. riboflavin, 8 mg. pantothenic acid, 18 mg. niacin, 20 mg. choline chloride and 10 mcg. vitamin B_{12} per pound of ration.

[b] Provided 1135 I.U. vitamin A, 340 I.U. vitamin D, 2 mg. riboflavin, 4 mg. calcium pantothenate, 9 mg. niacin, 10 mg. choline chloride and 7 mcg. vitamin B_{12} per pound of ration.

Results

Trial I

The results of the first trial with early weaned pigs are shown in table 2. Pigs receiving either 10 or 100 gm. of spectinomycin per ton of feed gained significantly ($P < .01$) faster than the pigs fed the basal ration. The pigs receiving the antibiotic got off to a much better start than did those pigs fed the basal ration. The control pigs gained very little during the first two weeks of the trial.

Feed consumption was also much greater in the lots fed spectinomycin and reflects their faster growth rate. Feed efficiency was more variable particularly in the lots fed the basal or the 10 gm. level of spectinomycin. Pigs receiving the 100 gm. level of spectinomycin consistently required less feed per unit of gain and averaged approximately 15% less feed than the pigs fed the control ration and 20% less feed than those pigs fed the low level of antibiotic.

Table 2. Performance of Early-Weaned Pigs Fed Spectinomycin

Spectinomycin (gm./ton)		0	10	100
No. of pigs[a]		16	16	16
Av. init. wt., lb.		14.2	13.8	13.9
Av. final wt., lb.		30.7	36.7	41.3
Av. daily gain, lb.	Rep. 1	0.48	0.68	0.84
	2	0.51	0.59	0.70
	3	0.42	0.71	0.80
	Av.	0.47	0.65[b]	0.78[b,c]
Av. daily feed, lb.	Rep. 1	1.11	1.56	1.76
	2	1.11	1.76	1.50
	3	1.18	1.73	1.57
	Av.	1.13	1.68	1.61
Av. feed per lb. gain, lb.	Rep. 1	2.31	2.29	2.08
	2	2.16	2.98	2.15
	3	2.79	2.44	1.96
	Av.	2.42	2.57	2.06

[a] Two pigs died or removed from each treatment.
[b] Significantly faster than control ($P < .01$).
[c] Significantly faster than 10 gm. level ($P < .05$).

Trial II

The results of trial II are summarized by treatment in table 3. Data for the 4 replicated lots per treatment are pooled, except for feed efficiency data, since lot differences did not appear important.

There was no significant difference in average daily gain between treatments. In most previous experiments at this station chlortetracycline has resulted in a growth response. Feed efficiency, however, was significantly ($P < .05$) improved by both chlortetracycline and the 10 gm. level of spectinomycin. Pigs fed rations containing these two antibiotics required approximately 7 percent less feed than the pigs fed the basal ration. This experiment was conducted during the winter months (Nov. 8 - Feb. 20) with pigs fed outside. Under these conditions the performance of all lots was quite good.

Table 3. Performance of Growing-Finishing Pigs Fed Spectinomycin or Chlortetracycline

Antibiotic (gm./ton)	0	Spectinomycin 10	Spectinomycin 20	Chlortetra-cycline 20
No. of pigs[a]	20	19	20	20
Init. wt., lb.	36.2	36.1	36.2	36.2
Final wt., lb.	201.8	201.3	201.3	201.9
Av. daily gain, lb.	1.67	1.70	1.65	1.73
Av. daily feed, lb.	5.67	5.40	5.39	5.46
Av. feed per lb. gain, lb.				
Rep. 1	3.39	3.22	3.10	3.17
2	3.49	2.97	3.21	3.12
3	3.29	3.22	3.36	3.20
4	3.34	3.26	3.40	3.09
Av.	3.40	3.17[b]	3.27	3.14[b]

[a] Four lots of 5 pigs each per treatment. One pig died in treatment 2.
[b] Significantly less than control ($P < .05$).

Summary

A new antibiotic, spectinomycin, was fed to early weaned pigs at levels of 10 and 100 gm. per ton. Both levels increased gains significantly ($P < .01$). Pigs fed the higher level of spectinomycin also gained significantly faster than those fed the lower level. Although pigs fed the antibiotic consumed more feed and those fed the high level of antibiotic required 15% less feed per unit of gain, these differences were not significant.

In a trial with growing-finishing pigs neither spectinomycin nor chlortetracycline increased gains. However, pigs fed 10 gm. of spectinomycin per ton or 20 gm. of chlortetracycline per ton required significantly ($P < .05$) less feed per unit of gain.

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A.S. Series 68-30

Supplemental Lysine in Feed or Water for Early Weaned Pigs

Richard C. Wahlstrom and Aaron R. Taylor

Previous work at this and other experiment stations has shown that many practical swine rations may be deficient in the amino acid lysine. This is particularly true of rations that may be somewhat low in protein for the younger pig since protein or amino acid requirements are higher during the early growth period. Last year it was reported here (A.S. Series 67-27) that pigs weaned at three weeks of age and fed rations minimal in protein content gained faster and more efficiently when lysine was added to the water or feed. The experiment reported herein was an attempt to confirm the previous results and also to study the effect of lysine on certain blood constituents.

Experimental Procedure

Twenty-four five week old pigs averaging about 20 pounds in weight were allotted into three groups of eight pigs each on the basis of litter, weight and sex. Each group was then randomly assigned to one of the three treatments which were:

Group 1 - Basal ration
Group 2 - Basal plus 0.3% supplemental lysine in feed
Group 3 - Basal plus lysine in water (equivalent to 0.3% in feed)

The pigs in this trial were kept in individual pens and feed and water was available ad libitum. Protein levels were adjusted throughout the experiment with levels calculated to be two percent suboptimum at all stages. The composition of the basal rations is shown in table 1.

Blood samples were collected at 0, 42 and 78 days after initiation of the trial. Analyses were made for hematocrit, red blood cell count, total serum protein, serum globulin and serum albumin.

Results

The results of this experiment are shown in table 2. Average daily gain and feed efficiency data are given for each of the three periods as well as for the average performance for the entire experiment.

During the first four weeks of this trial when the 16% protein ration was fed, pigs receiving supplemental lysine either in the feed or water gained approximately 0.2 pound per day faster than the control pigs and required from 10 to 15% less feed per pound of gain.

The control pigs were lighter in weight at 9 weeks of age when the rations were reduced to 14% protein. This fact along with their slower rate of gain resulted in a much longer period of time for them to reach a weight of approximately 75 pounds. Pigs receiving lysine gained significantly faster and more efficiently during this period. Average daily gains were 0.90, 1.43 and 1.42 pounds for the control, lysine in feed and lysine in water, respectively. The lysine supplemented pigs required about 20% less feed per unit of gain during this period.

The trends observed in average daily gains and feed efficiency during the third period were similar to those of the first two periods with lysine supplementation again resulting in increased gains and improved feed efficiency. For the entire 78 day trial, lysine supplementation gave significant improvement in daily gains and feed efficiency. Pigs fed the control ration gained 0.83 pound per day compared to 1.21 and 1.28 pounds for those receiving lysine in the feed or water. Pounds of feed required per pound of gain were 2.96, 2.63 and 2.58 for pigs fed the control or lysine in feed or water, respectively. There did not appear to be any difference in the method of supplementation as pigs receiving the supplemental lysine in the feed or in the water performed similarly.

Of the various blood components studied only serum albumin indicated a difference because of lysine supplementation. This blood protein constituent increased due to lysine supplementation. Total serum protein, serum globulin, hematocrit and red blood cell counts all increased with increasing age of pigs but did not differ due to lysine supplementation.

Summary

Early weaned pigs weighing 20 pounds were fed 16% protein rations from 5 to 9 weeks of age, 14% protein rations from 9 weeks to 75 pounds and 12% protein rations from 75 pounds to approximately 115 pounds. These rations contained 0.67, 0.54 and 0.41% lysine, respectively. Supplementation of 0.3% lysine to the feed or to the water (equivalent to 0.3% in feed) resulted in increased gains and feed efficiency indicating that the basal rations were deficient in lysine content for pigs of this size.

Serum albumin was higher in the blood of pigs receiving supplemental lysine, but total serum protein, serum globulin, hematocrit or red blood cell count were not affected by lysine content of the ration.

Table 1. Composition of Rations, Percent

Feeding period	5 to 9 wks. of age	9 weeks to 75 lbs.	75 to 115 lbs.
Crude protein	16%	14%	12%
Ground shelled corn	54.0	84.3	89.0
Rolled oats	30.0	----	----
Soybean meal, 50%	13.0	12.8	8.0
Dicalcium phosphate	1.6	1.6	1.8
Limestone	0.6	0.5	0.3
Trace mineral salt	0.5	0.5	0.5
Vitamin-antibiotic	0.3[a]	0.3[b]	0.3[b]

[a] Provided 1135 I.U. vitamin A, 340 I.U. vitamin D, 4 mg. riboflavin, 8 mg. calcium pantothenate, 16 mg. niacin, 20 mg. choline chloride, 10 mcg. vitamin B_{12} and 1.13 gm. SP-250 per pound of ration.

[b] Provided 1135 I.U. vitamin A, 340 I.U. vitamin D, 2 mg. riboflavin, 4 mg. calcium pantothenate, 9 mg. niacin, 10 mg. choline chloride, 7 mcg. vitamin B_{12} and 5 mg. chlortetracycline per pound of ration.

Table 2. Supplemental Lysine in Feed or Water for Early Weaned Pigs

	Control	Lysine in Feed	Lysine in Water
	Period I		
Days on experiment	28	28	28
Av. daily gain, lb.	0.69	0.87	0.92
Av. feed per lb. gain, lb.	2.68	2.40	2.25
	Period II		
Days on experiment	36.6	22	21
Av. daily gain, lb.	0.90	1.43*	1.44*
Av. feed per lb. gain, lb.	2.77	2.24**	2.23**
	Period III		
Days on experiment	13.4	28	29
Av. daily gain, lb.	0.91	1.38**	1.51**
Av. feed per lb. gain, lb.	4.00	3.10*	3.01*
	Total Periods I, II, and III		
Av. initial wt., lb.	20.0	19.7	20.4
Av. final wt., lb.	84.7	112.7	118.6
Av. daily gain, lb.	0.83	1.21*	1.28*
Av. daily feed, lb.	2.46	3.12	3.30
Av. feed per lb. gain, lb.	2.96	2.63*	2.58*
Days on experiment	78	78	78

* Significantly different from control ($P < .05$).
** Significantly different from control ($P < .01$).

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A.S. Series 68-31

Rations for Early Weaned Pigs

Richard C. Wahlstrom and Donald Mordhorst

One of the most critical times in the nutrition of the pig is during the first few weeks after weaning. This is particularly true if the pigs are weaned at an age of 3 to 4 weeks or younger. During the past two years an experiment has been in progress at this station to study different ration ingredients in rations for pigs weaned at about 3 weeks of age in order to determine if more economical rations can be developed that will be highly palatable and support rate and efficiency of gains comparable or superior to more complex rations.

The trials reported here were designed to study certain feed additives as growth promotants, to compare a simple and more complex ration and to study the effect of protein level in rations for early weaned pigs.

Experimental Procedure

Sixty-three pigs averaging about 4 weeks of age were used in the first trial. The pigs were allotted into 9 lots of seven pigs each with three lots receiving each of the following three ration treatments per ton of feed:

Treatment 1 - 100 gm. chlortetracycline, 100 gm. sulfamethazine and 50 gm. penicillin
Treatment 2 - 100 gm. Tylan
Treatment 3 - 100 gm. Tylan and 100 gm. sulfamethazine

The pigs were confined in inside pens 8 ft. x 10 ft. with water and feed provided ad libitum. The trial was conducted for 28 days. Composition of the ground ration is shown in table 1.

In trial II, 80 pigs approximately 3 weeks of age were allotted into two replicate groups of five lots each and fed for 5 weeks. Management was similar to trial I. The composition of the rations is shown in table 2. A fortified complex ration containing corn, rolled oats, soybean meal, dried skim milk and sugar was compared to a simple fortified corn-soybean meal ration at both 20% and 16% protein levels. Treatments were as follows:

Treatment 1 - Complex 20% protein ration
Treatment 2 - Corn-Soy 20% protein ration
Treatment 3 - Corn-Soy 16% protein ration
Treatment 4 - Complex 16% protein ration
Treatment 5 - Corn-Soy 20% protein ration plus neomycin

Table 1. Composition of Basal Ration, Trial I

	Percent
Ground yellow corn	38.0
Rolled oats (hulled)	30.0
Soybean meal (50%)	24.0
Sugar	5.0
Dicalcium phosphate	1.6
Ground limestone	0.6
Trace mineral salt	0.5
Vitamin premix[a]	0.3

[a] Provided 1135 I.U. vitamin A, 340 I.U. vitamin D, 4 mg. riboflavin, 8 mg. calcium pantothenate, 16 mg. niacin, 20 mg. choline and 10 mcg. vitamin B_{12} per pound of ration.

Table 2. Composition of Rations, Trial II (Percent)

	Complex 20% C.P.	Corn-Soy 20% C.P.	Corn-Soy 16% C.P.	Complex 16% C.P.	Corn-Soy 20% C.P. + Neomycin
Ground yellow corn	34.0	69.0	80.0	44.0	69.0
Rolled oats (hulled)	30.0	--	--	30.0	--
Soybean meal (50%)	18.0	27.5	17.0	8.0	27.5
Dried skim milk	10.0	--	--	10.0	--
Sugar	5.0	--	--	5.0	--
Dicalcium phosphate	1.4	2.0	1.7	1.6	2.0
Ground limestone	0.6	0.6	0.6	0.6	0.6
Trace mineral salt	0.5	0.5	0.5	0.5	0.5
Vitamin-antibiotic premix	0.3[a]	0.3[a]	0.3[a]	0.3[a]	0.3[b]

[a] Provided 1135 I.U. vitamin A, 340 I.U. vitamin D, 4 mg. riboflavin, 8 mg. calcium pantothenate, 16 mg. niacin, 20 mg. choline, 10 mcg. vitamin B_{12}, 50 mg. aureomycin, 50 mg. sulfamethazine and 25 mg. penicillin per pound of ration.

[b] All vitamins as listed above plus 25 mg. aureomycin, 25 mg. sulfamethazine, 12.5 mg. penicillin and 25 mg. neomycin per pound of ration.

Table 3. Summary of Trial I

	Chlortetracycline Sulfamethazine Penicillin	Tylan	Tylan Sulfamethazine
No. of pigs	20[a]	19[b]	19[b]
Av. initial wt., lb.	17.0	17.2	17.2
Av. final wt., lb.	41.1	35.9	38.5
Av. daily gain, lb.	0.86	0.69	0.76
Av. daily feed, lb.	1.58	1.39	1.63
Av. feed per lb. gain, lb.	1.84	2.03	2.14

[a] Three lots of seven pigs each, one pig removed.
[b] Three lots of seven pigs each, one pig died, one pig removed.

Table 4. Summary of Trial II

	Rep.	Complex 20% C.P.	Corn-Soy 20% C.P.	Corn-Soy 16% C.P.	Complex 16% C.P.	Corn-Soy 20% C.P. + Neomycin
No. of pigs	1	7[a]	8	8	7[a]	8
	2	8	7[a]	8	7[a]	8
Av. init. wt., lb.	1	16.7	17.2	17.2	17.4	17.2
	2	13.6	13.9	13.6	13.7	13.5
Av. final wt., lb.	1	48.4	42.4	38.5	40.3	43.1
	2	33.5	32.4	32.8	30.6	38.8
Av. daily gain, lb.	1	0.91	0.72	0.61	0.65	0.74
	2	0.57	0.53	0.55	0.48	0.72
	Av.	0.73	0.63	0.58	0.57	0.73
Av. daily feed, lb.	1	1.81	1.58	1.66	1.63	1.54
	2	1.25	1.59	1.24	1.31	1.43
Av. feed per lb. gain, lb.	1	2.00	2.20	2.73	2.50	2.09
	2	2.21	3.00	2.26	2.73	1.98
	Av.	2.08	2.52	2.51	2.60	2.03

[a] One pig died, data not included.

Results

A summary of the results of trial I is presented in table 3. Pigs receiving the chlortetracyline-sulfamethazine-penicillin combination gained faster and more efficiently than pigs fed the other additives. One of the three lots receiving Tylan in the feed had a lower feed intake and gained only 0.54 pound per day which resulted in the lower average rate of gain for this treatment. Feed efficiency was quite good for all treatments although considerable variation existed between lots even on the same treatment.

Table 4 summarizes the results of trial II. The data are presented for each replicate since the heavier pigs were allotted to replicate 1 and the lighter pigs to replicate 2.

Although there was no difference in average age of the pigs in the two replicates the heavier pigs gained faster than the lighter pigs in each treatment. This was due primarily to their faster adjustment to the ration after weaning and a greater consumption during the first two weeks of the trial.

Pigs fed the 20% protein rations gained faster than those fed the 16% protein rations in replicate 1 but the difference in gains was negligible in replicate 2 except for treatment 5. This is difficult to explain since we have conducted much research that indicates a 16% protein ration is not adequate for pigs of this age and weight.

Another reason for feeding a 16% protein ration was to see if differences existed in feces consistency as it is often claimed that scouring in young weaned pigs is due to protein level of the ration. In this trial scouring was observed in the pigs fed the complex 20% protein ration containing dried skim milk, rolled oats and sugar in addition to corn and soybean meal. The scouring commenced near the end of the first week and persisted for several days, however, the pigs continued to gain during this period and were the fastest gaining pigs during the entire trial.

Pigs fed the 20% protein corn-soy ration containing neomycin gained faster and more efficiently than those pigs fed a similar ration without neomycin. It was observed that the pigs receiving neomycin appeared to adjust to the ration and the stress of weaning much more rapidly as in both replicates these pigs had the greatest gains the first week of the experiment.

Summary

Three week old pigs weighing approximately 17 pounds gained about 25% faster than pigs weighing 13.5 pounds during a five week post weaning period. Pigs fed rations of 20% crude protein gained about 0.10 pound per day faster than those fed 16% protein rations and also required less feed per pound of gain. The complex ration containing dried skim milk, sugar and rolled oats as additional ingredients appeared to be preferred to the corn-soy ration at the 20% protein level but not at the 16% protein level. Neomycin added to the 20% protein corn-soy ration resulted in gains and efficiency similar to the complex 20% protein ration.

Pigs fed rations containing a chlortetracycline-sulfamethazine-penicillin combination gained faster and more efficiently than those fed Tylan or Tylan-sulfamethazine combination.

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A.S. Series 68-32

Calcium and Phosphorus Levels in Rations for Growing-Finishing Swine

Richard C. Wahlstrom and Larry De Goey

Calcium and phosphorus have long been recognized as mineral elements that are seriously deficient in cereal grains and plant by-products. However, some questions arise as to the availability of these minerals, particularly phosphorus, in cereal grains and by-products and the requirements of swine for these minerals. Evidence of lameness of growing-finishing swine is often associated with a calcium or phosphorus problem in the ration although these minerals may or may not be a factor related to this condition.

This experiment was conducted to study the effects of corn-soybean meal rations containing varying levels of added calcium and phosphorus on growth performance, carcass characteristics and levels of calcium and phosphorus in the blood serum of growing-finishing swine.

Experimental Procedure

Sixty-four weanling crossbred pigs were used in Trial 1 and allotted into 8 lots of 8 pigs each. Two lots of pigs received each of the four ration treatments which varied only in phosphorus content. Calcium was included in all rations at approximately 0.60 percent of the ration. Total phosphorus content of the four ration treatments was 0.40, 0.50, 0.61 and 0.81 percent. However, if one assumes, as has been suggested by some research workers, that the phosphorus in corn and soybean meal is only about 40% available to the pig, the levels of phosphorus in the rations fed would then be 0.2, 0.3, 0.4 and 0.6 percent and the calcium to phosphorus ratios would be 3:1, 2:1, 1.5:1 and 1:1. The composition of the rations fed is shown in table 1.

In Trial II, 64 pigs were allotted, 8 pigs per lot, four barrows and four gilts, into two replicated groups of 4 lots each. The rations shown in table 2 were similar to those in Trial I except that calcium and phosphorus levels were different. The level of these two mineral elements in each ration is also shown in table 2. The levels were all equal to or in excess of the requirements for calcium and phosphorus as listed by the National Research Council.

In both trials pigs were confined on concrete with feed and water supplied ad libitum in outside lots. In Trial II all barrows, 8 from each treatment, were slaughtered at an approximate weight of 210 pounds. Blood samples were taken at this time for determination of calcium and phosphorus of the serum and carcass data were collected.

Results

Trial I

Results of Trial I are reported in table 3. Although the two replicate groups averaged about 10 pounds difference in initial weight, the data for replicated lots are combined as the response was similar in both replicates.

Pigs receiving the highest level of phosphorus (0.8%) in their ration gained 11 percent faster than those receiving the lowest level (0.4% total phosphorus or 0.2% available). This level is below the NRC recommendation of 0.5% for pigs from 25 to 75 pounds but equal to the recommendation for pigs from 75 to 225 pounds. In this trial a difference in rate of gain was noted at the time the pigs weighed about 75 pounds. At this time the daily gain of pigs receiving the lowest level of phosphorus averaged about 0.12 pound per day less than the gain of pigs fed the other three levels of phosphorus. Feed efficiency was somewhat variable between treatment groups but did not indicate any trend due to phosphorus levels in the ration.

Trial II

Table 4 summarizes the results of the second trial. Data for the two replicate groups have been combined since both groups had similar performance.

There was no difference in average daily gain between treatments. Pigs receiving increased levels of phosphorus did not show increased gains as had been noted in Trial I. Likewise increasing the calcium level to 1.2% did not affect rate of gain but pigs fed this level of calcium did require slightly more feed per unit of gain.

Serum calcium and phosphorus levels did not differ significantly between treatments. There did not appear to be any trend between level of calcium or phosphorus in the diet and the level of these elements in the blood. Carcass characteristics between groups indicate some differences in average figures of certain traits. However, since only eight animals are involved these differences are not significant.

Summary

Two trials were conducted to study the effect of various calcium and phosphorus levels in the ration on performance of growing-finishing swine. Pigs fed rations containing 0.4% total phosphorus gained more slowly than pigs fed rations containing 0.5, 0.6 or 0.8% phosphorus. All rations contained 0.6% calcium. Increasing phosphorus above the National Research Council recommendations of 0.5% to 75 pounds and 0.4% from 75 pounds to market weight did not affect rate or efficiency of gain, blood serum calcium and phosphorus levels or carcass characteristics. Increasing the calcium level in the ration to 1.2% to 110 pounds and 0.9% from 110 pounds to market weight did not significantly affect pig performance although these pigs required slightly more feed per unit of gain and had about 10% more backfat than those fed the recommended levels of calcium.

There were no visible signs of differences in leg strength, lameness or turbinate atrophy between pigs fed the various levels of calcium and phosphorus in these trials.

Table 1. Composition of Rations (Percent), Trial I

Phosphorus level	Initial to 110 lbs.				110 to 200 lbs.			
	0.4	0.5	0.6	0.8	0.4	0.5	0.6	0.8
Ground yellow corn	79.0	79.0	79.0	79.0	89.0	89.0	89.0	89.0
Soybean meal (50%)	18.0	18.0	18.0	18.0	8.0	8.0	8.0	8.0
Ground limestone	1.2	0.9	0.5	--	1.2	0.85	0.55	--
Dicalcium phosphate	0.4	0.9	1.5	2.25	0.45	1.00	1.50	2.35
Disodium phosphate	--	--	--	0.25	--	--	--	0.25
Trace mineral salt	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.50
Vitamin-antibiotic premix[a]	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Calculated analysis								
Protein, %	16.1	16.1	16.1	16.1	12.0	12.0	12.0	12.0
Calcium, %	0.61	0.62	0.61	0.60	0.60	0.60	0.61	0.60
Phosphorus (total), %	0.40	0.50	0.61	0.81	0.38	0.48	0.58	0.79
Phosphorus available, %[b]	0.20	0.30	0.41	0.61	0.20	0.30	0.40	0.61

[a] Provided 1125 I.U. vitamin A, 340 I.U. vitamin D, 2 mg. riboflavin, 4 mg. calcium pantothenate, 9 mg. niacin, 10 mg. choline chloride, 10 mcg. vitamin B_{12} and 12.5 mg. chlortetracycline per pound of ration.

[b] Based on assumption that only 40% of phosphorus in corn and soybean meal is available.

Table 2. Composition of Rations (Percent), Trial II

	Initial to 110 lbs.				110 to 200 lbs.			
Calcium level	0.65	0.65	0.65	1.2	0.50	0.50	0.50	0.90
Phosphorus level	0.50	0.65	0.85	0.6	0.40	0.50	0.68	0.45
Ground yellow corn	79.8	79.5	79.0	77.8	90.1	89.9	89.4	88.8
Soybean meal (50%)	17.7	17.7	17.7	18.0	7.9	7.9	7.9	8.0
Ground limestone	1.0	0.5	--	2.1	0.85	0.5	--	1.76
Dicalcium phosphate	0.9	1.7	2.45	1.5	0.55	1.1	1.95	0.8
Disodium phosphate	--	--	0.25	--	--	--	0.1	--
Trace mineral salt	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Vitamin-antibiotic premix[a]	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1

[a] Provided 1125 I.U. vitamin A, 340 I.U. vitamin D, 2 mg. riboflavin, 4 mg. calcium pantothenate, 9 mg. niacin, 10 mg. choline chloride, 10 mcg. vitamin B_{12} and 12.5 mg. of chlortetracycline per pound of ration.

Table 3. Results of Varying Levels of Phosphorus in Swine Rations

	Phosphorus levels, %			
	0.4	0.5	0.6	0.8
No. of pigs	16[a]	15[b]	16	16
Initial wt., lb.				
Rep. I	43.8	44.7	43.8	43.5
Rep. II	33.6	33.6	33.6	33.4
Final wt., lb.	201.4	202.6	205.4	205.9
Av. daily gain, lb.	1.47	1.52	1.55	1.64
Av. daily feed, lb.	5.41	5.98	5.61	5.90
Av. feed/lb. gain, lb.	3.69	3.92	3.60	3.60

[a] Two replicate lots of 8 pigs each.
[b] One pig died in replicate I, data are for 7 pigs in that replicate.

Table 4. Results of Different Levels of Calcium and Phosphorus in Swine Rations

Calcium level, %[a]	0.65-0.50	0.65-0.50	0.65-0.50	1.2-0.90
Phosphorus level, %[a]	0.50-0.40	0.65-0.50	0.85-0.68	0.6-0.45
No. of pigs[b]	16	16	16	16
Initial wt., lb.	36.4	36.5	36.5	36.4
Final wt., lb.	210.2	209.2	213.8	210.5
Av. daily gain, lb.	1.61	1.65	1.62	1.60
Av. daily feed, lb.	5.22	5.25	5.20	5.45
Av. feed/lb. gain, lb.	3.24	3.18	3.22	3.40
Serum calcium, mg. %	10.58	10.46	10.18	10.11
Serum phosphorus, mg. %	9.36	8.49	8.16	8.44
Av. backfat, in.	1.34	1.36	1.40	1.52
Av. length, in.	29.8	29.8	30.2	30.0
Av. loin eye area, sq. in.	4.28	4.51	4.99	4.21
Percent ham and loin	36.48	35.68	36.45	36.40

[a] Levels of calcium and phosphorus in rations fed to 110 lb. and from 110 to 200 lb.
[b] Two lots of 8 pigs each per treatment.

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A.S. Series 68-33

Estrus Synchronization and Artificial Insemination of Swine

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For years scientists have been trying to find drugs or hormones that will control the reproductive cycle and bring gilts into estrus together to be bred at the same time. The only compound tested to date which has been successful in achieving this goal without also producing undesirable side effects is one called by the tradename Aimax. During a normal estrous cycle, gonadotropic hormones are released from the pituitary gland and are carried by the blood to the ovary where these hormones stimulate the production of estrogen by the ovary and cause ovulation. When Aimax is fed to female swine, it prevents the release of gonadotropic hormones from the pituitary gland. Without stimulation from gonadotropic hormones, ovulation does not occur and the ovary does not produce the estrogen needed to bring sows and gilts into estrus. Thus, Aimax fed to sows or gilts prevents them from ovulating or coming into estrus. Most females will then exhibit estrus accompanied by ovulation five to seven days following withdrawal of Aimax from the feed.

With the increasing interest among South Dakota Swine Producers in estrus synchronization and artificial insemination, this study was made to compare these techniques with unsynchronization and natural service under practical farm conditions in South Dakota.

Experimental Procedure

During February 1968, 88 10-month old Duroc-Yorkshire crossbred gilts were randomly allotted into four treatment groups of 22 gilts each: (1) natural service, estrus unsynchronized, (2) natural service, estrus synchronized with Aimax, (3) artificial insemination, estrus unsynchronized and (4) artificial insemination, estrus synchronized with Aimax. All gilts were fed 4.5 lb. daily of a 16% protein corn-soybean meal ration for the 25-day period prior to the beginning of breeding, during breeding and for the 30-day period following breeding. The estrus synchronized gilts were fed 100 mg. of Aimax per head per day during the 20-day period which ended 5 days prior to the beginning of breeding. During gestation from 30 days after breeding to farrowing, the gilts were fed a 13% protein corn-soybean meal ration, the daily amount of which varied from gilt to gilt in order to keep the weight gains of the gilts during gestation at a minimum.

The gilts were either inseminated artificially or bred by natural service 12 hr. after they were first detected in standing estrus following withdrawal of Aimax from the feed. Each gilt received only one insemination or natural service

from one of nine Yorkshire boars and none of those failing to conceive at first service were rebred. The gilts inseminated artificially each received 50 ml. of fresh, whole semen within 2 hr. after it had been collected.

Due to a lack of facilities to farrow all the gilts, only 47 gilts were allowed to farrow. Since the gilts chosen to farrow had all been bred within an 8-day period, there were many more synchronized than unsynchronized gilts that farrowed. All gilts not allowed to farrow were slaughtered 30 days after breeding and their reproductive tracts were recovered and examined for number of corpora lutea present on the ovaries and number of live embryos present in the uterus.

Results and Discussion

Table 1 shows the number of gilts first showing estrus on each of the 20 days immediately following withdrawal of Aimax from the feed. Thirty-eight of the synchronized gilts (86%) exhibited their first day of standing estrus within a 3-day period and all exhibited estrus within an 8-day period. On the other hand, only 10 unsynchronized gilts (23%) exhibited estrus within a 3-day period and 20 days had elapsed before all 44 unsynchronized gilts came into estrus. The two synchronized gilts first showing estrus on days 10 and 12 following withdrawal of the drug were observed in estrus during the period the drug was being fed. This may be due to the fact that during severe cold weather (-20°F.) at the beginning of the drug feeding period these gilts were returning to shelter before they had consumed their fair share of feed. Therefore, they did not receive sufficient amounts of Aimax on those days to inhibit the release of gonadotropic hormones. This resulted in these gilts coming into estrus while the other gilts receiving sufficient feed were suppressed from exhibiting estrus.

Because of variation between gilts in length of gestation (range from 111 to 118 days), the gilts did not farrow as close together as they were bred. Of the 33 synchronized gilts which were allowed to farrow, 30 were bred within a 2-day period and all 33 were bred within a 4-day period. However, only 19 gilts farrowed within a 2-day period and 7 days were required before all 33 gilts had farrowed. Since treatment had no effect on length of gestation as shown in table 2, the variation in length of gestation which exists between gilts is independent of estrus synchronization, and gilts bred on the same day will not necessarily farrow on the same day.

The results of this experiment are in agreement with results reported by other workers in that most gilts exhibited estrus within a 3-day period 5 to 7 days after withdrawal of Aimax from the feed and that conception rate at first service of the synchronized gilts was equal to that of the unsynchronized controls. Table 2 also shows that type of mating and synchronization had no significant effect on conception rate, litter size, eggs ovulated, 30-day embryos present, pigs farrowed dead or degenerate pigs farrowed.

The results of this study show that estrus synchronization and artificial insemination of swine can be used together in a practical and effective manner to decrease time spent on breeding and farrowing, to farrow litters closer

together resulting in a more uniform group of pigs and to make more efficient use of a superior sire resulting in a conception rate and litter size equal to that obtained from natural service of unsynchronized gilts.

Table 1. Number of Gilts Exhibiting Estrus Following Withdrawal of Aimax From the Feed[1]

	Days Following Withdrawal of Aimax																			
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Unsynchronized Gilts																				
Number in Estrus Each Day[2]	1	6	0	2	2	0	4	1	4	1	2	1	3	2	3	3	4	1	2	2
Total in Estrus to Date	1	7	7	9	11	11	15	16	20	21	23	24	27	29	32	35	39	40	42	44
Synchronized Gilts																				
Number in Estrus Each Day	0	0	0	0	5	20	13	1	3	1	0	1	0	0	0	0	0	0	0	0
Total in Estrus to Date	0	0	0	0	5	25	38	39	42	43	43	44	44	44	44	44	44	44	44	44

[1] Although the duration of estrus of a gilt usually lasts 2 to 3 days, the gilts are counted in the table only on the day they first exhibited standing estrus.

[2] The maximum number of unsynchronized gilts in estrus in any consecutive 3-day period was 10 (23% of all unsynchronized gilts) while the maximum number of synchronized gilts in estrus in any consecutive 3-day period was 38 (86% of all synchronized gilts). These differences between treatments were highly significant ($P < .01$).

Table 2. Influence of Estrus Synchronization and Artificial Insemination on the Reproductive Performance of Gilts[1]

	Treatment Group				
	1 N.S. Un.	2 N.S. Syn.	3 A.I. Un.	4 A.I. Syn.	All Gilts
Gilts per Treatment	22	22	22	22	88
Gilts Conceiving at First Service	18	19	16	19	72
Percent Conception	82	86	73	86	82
Pregnant Gilts Slaughtered	9	2	11	3	25
Eggs Ovulated per Gilt	17.1	17.5	17.2	17.0	17.2
Embryos per Gilt	14.0	12.5	13.3	9.7	13.0
Gilts Farrowing	9	17	5	16	47
Length of Gestation Period	113.4	113.4	113.8	113.4	113.5
Pigs Farrowed per Gilt	10.9	10.9	11.0	10.1	10.6
Pigs Farrowed Alive per Gilt	10.8	10.6	10.4	9.9	10.4
Pigs Farrowed Dead per Gilt	0.1	0.3	0.6	0.2	0.2
Degenerate Pigs per Gilt	0.2	0.5	0.0	0.7	0.4

[1] There were no significant differences between treatment groups for any of the characteristics measured.

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A.S. Series 68-34

Combining Barley and Oats for Growing-Finishing Gilts

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Northcentral South Dakota is an area in which corn is not produced in sufficient quantity for livestock feed needs. Since barley and oats are also produced in the area, both are used singly or in combination for swine production. Work at the Northcentral Substation, Eureka, has demonstrated that properly supplemented all-barley rations support rapid growth and efficient gains for swine. Because of interest in the area in using oats also for swine rations this trial was designed to compare barley alone with combinations of barley and oats.

Ration Treatments

Treatment comparisons using adequately supplemented rations were as follows:

1. All barley - control
2. Barley 2 parts, oats 1 part
3. Equal parts barley and oats
4. Barley 1 part, oats 2 parts

Table 1 outlines composition of the growing and finishing rations fed.

Table 1. Composition of Rations

Treatment	1		2		3		4	
	Grow	Finish	Grow	Finish	Grow	Finish	Grow	Finish
			Ration Ingredients					
Barley	823	908	548	606	412	454	275	302
Oats	--	--	275	302	411	454	548	606
			Supplement for all rations					
			Grow		Finish			
Soybean oil meal (44%)			150		70			
Dicalcium phosphate			15		11			
Ground limestone			5		4			
Trace mineralized salt (high zinc)			5		5			
Premix[1]			2.5		2.5			
			Calculated Analyses of Rations					
Protein	16.1	13.5	16.2	13.7	16.3	13.8	16.3	13.8
Calcium	0.64	0.50	0.65	0.50	0.66	0.51	0.66	0.52
Phosphorous	0.66	0.57	0.65	0.55	0.64	0.54	0.63	0.54

[1] Each pound of premix provided 2 gm. oxytetracycline, 600,000 U.S.P. units vitamin A, 60,000 I.U. vitamin D_3, 400 mg. riboflavin, 1,000 mg. d-pantothenic acid, 3,000 mg. niacin, 23,044 mg. choline chloride, 3 mg. vitamin B_{12} activity.

Experimental Procedures

One hundred crossbred SPF gilts all by the same sire were allotted to 4 treatments on the basis of litter and weight. Each lot was grown out in a grass-alfalfa pasture approximately one-half acre in area. Facilities in each lot included a shade-shelter, self-feeder and watering fountain. Both grower and finisher rations were self-fed, with the change to finisher rations being made when the lot average weight was 110 to 120 pounds. At the periodic weighing times, gilts reaching weights of 185 pounds or more were probed for backfat thickness and removed from the treatment lots.

Results and Discussion

Previous work at the Eureka Station has shown that properly supplemented barley rations support rapid, efficient gains for growing-finishing swine. Trials at other locations comparing corn rations with those in which part of the corn had been replaced by oats have shown that up to one-third of the grain may be oats without decreasing gain or feed efficiency. Data comparing combinations of barley and oats, as in this trial, were not available. Use of such combinations indicated the desirability of making these comparisons. Results of the trial are summarized in Table 2.

Table 2. Performance of Growing-Finishing Gilts Fed Barley and Barley-Oats Rations

Treatment	1 Control All Barley	2 2 Barley 1 Oats	3 1 Barley 1 Oats	4 1 Barley 2 Oats
Number of gilts	25	25	25	25
Average initial weight	82.5	78.5	79.6	78.8
Average final weight	197.5	198.8	194.5	198.9
Average daily gain	1.62	1.66	1.56	1.60
Feed per pound of gain	3.60	3.59	3.56	3.62
Average backfat probe[1]	0.89	0.89	0.83	0.83

[1] The average of three probes made (1) above the elbow, (2) above the last rib and (3) mid-way between the last rib and base of the tail.

Based on this single unreplicated trial there were only small differences in performance resulting from these ration treatments. Gilts fed a combination of two parts barley and one part oats gained most rapidly but not importantly more than gilts on any other treatment. Gilts fed equal parts of barley and oats gained least rapidly but were most efficient in feed usage. Differences in feed utilization were essentially not different.

Gilts fed the two rations with higher levels of barley gained somewhat more rapidly and had thicker backfat probes than gilts fed the higher level oat rations. All of these differences were small. However, the relationship between more rapid gain and more backfat was similar to that reported in some other work. It is not clear from this trail whether grain composition of the ration is important in these results.

Under the conditions of this trial, the results suggest that any of the rations compared would be satisfactory for the production of growing-finishing gilt pigs. It should be pointed out that pigs used in this trial had a rather high starting weight of approximately 80 pounds. Differences might be somewhat greater for pigs fed rations similar to these if treatments are begun with pigs immediately following weaning.